

**ACHARYA NARENDRA  
DEV COLLEGE**

**University Of Delhi**

**ELITE PROJECT**

**HYDROGEN SULPHIDE ( $\text{H}_2\text{S}$ ),  
AMMONIA GAS ( $\text{NH}_3$ ) EMANATED  
BY THE YAMUNA ARE POISONING  
THE AIR**

**Presented By Students of Mathematics  
Department**

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# Acknowledgement

B.Sc. Maths (Hons)

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# Introduction

The Yamuna is one of the oldest rivers of India and is used by millions as a source of drinking water, bathing and irrigation. In recent years, however, it has become grossly polluted due to various causes affecting human health and biodiversity of the eco-system.

Due to the decomposition of sewer, factory waste and other waste in the Yamuna, hydrogen sulfide and ammonia gases are emanated from it.

Hydrogen sulfide and ammonia create respiratory and skin problems.

# Origin of the Yamuna



The Yamuna originates from the Yamunotri glacier of Uttar Kashi in Uttar Pradesh. The river Yamuna covers a distance of 1200km in the plains starting from Saharanpur district of Uttar Pradesh meeting at Sangam in Allahabad and ending at Gangasagar in Bengal. But there are other rivers like river Giri which meets the Yamuna at Dakpathar in U.P. River Chambal joins the Yamuna in U.P. at Juhikha. River Betwa joins river Yamuna at the downstream of Hamirpur(M.P). River Mandakini and Ken are the last tributaries of river Yamuna before it joins river Ganga.

# The Yamuna in Delhi

The Yamuna has pure and clean water before it enters Delhi at Wazirabad. Truly, the Yamuna is believed to be black by nature but it is neither toxic nor polluted nor harmful. But as soon as it enters Delhi, it becomes polluted .

The Yamuna's 22-km stretch in Delhi is barely 2 per cent of the length of the river but contributes over 70 per cent of the pollution load.



# Flow of the Yamuna in Delhi

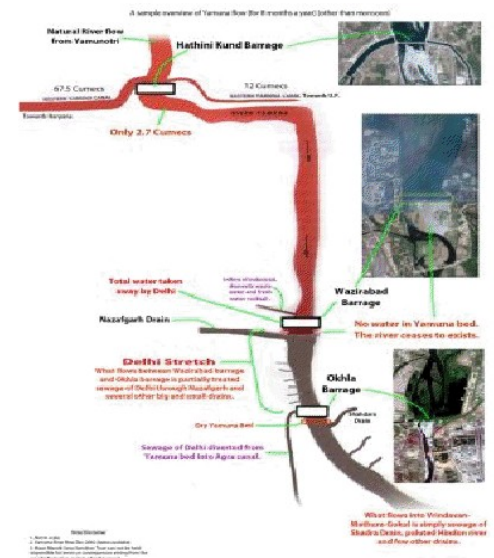
The 22 km segment of Yamuna River is located in between Wazirabad barrage and Okhla barrage. This segment receives water from seventeen sewage drains of Delhi and also from WJC and Upper Ganga Canal via Najafgarh drain and Hindon cut canal .

The Yamuna has become dirtier and Delhi is its biggest polluter, followed by Agra, Ghaziabad and Faridabad.

## RIVER YAMUNA IN DELHI

Flow of river Yamuna within Delhi is regulated by 3 barrages :

Wazirabad Barrage  
ITO Barrage  
Okhla Barrage



# Pollution and Toxicity



# Pollution and Toxicity

When the Yamuna leaves Delhi, it carries toxic and other pollutants to other tributaries including the Ganga. Knowingly or unknowingly, the people of Delhi are polluting the Yamuna.

Delhi discharges about 3,684 MLD (million liters per day) of sewage into the Yamuna.

The faecal coliform count, which indicates the presence of disease causing micro-organisms, is nearly 25,000 times more than the limit prescribed for bathing.

# Pollution and Toxicity

A Central Pollution Control Board study on river water quality at the upstream of Wazirabad shows dissolved oxygen (DO) level at 7.5 mg/l and BOD (Biochemical oxygen demand) level at 2.3 mg/l.

At downstream Okhla, the DO level declined to 1.3 mg/l with the BOD at 16 mg/l, indicating considerable deterioration in the water quality due to discharge of sewage and industrial effluents.

# Pollution and Toxicity

There are 17 drains entering the Yamuna in Delhi and almost 3,500 million litres of waste water enters the Yamuna everyday without any treatment.

The Najafgarh drain contributes to 60% of the total wastewater and 45 per cent of the total BOD load being discharged from Delhi into the Yamuna. The municipal wastewater increased from 960 MLD in 1977 to 1,900 MLD in 1997.



# Why we chose this topic....

The studies conducted by Jain (2003), Aggarwal, P K and Kalra, N., (1994); Aggarwal, P of the water pollution of the river K., et. al. (2003); Bachelet, D., and Gay, C. A., (1993); Benioff, R., et. al. (1996); Burton, I., et. al., (1998); Carter, T R., et. al. (1994); Glantz, M. H., (1998) ; Gosain A K., and Rao, S., (2003) ; IPC,C, 2001b; Sinha, S K. and Swaminathan, M S., (1991); Timmerman, P (1994); UNEP, 1998; UNFCCC, 1999; Woodward, F. I., et al. (1995), CES (2001, 2002, 2003, 2004) on water pollution on various river systems.

# Why we chose this topic....

But none of the scientists worked on the pollution in the Yamuna. After reading the effects of a polluted Yamuna ,we decided to work on the project titled “Hydrogen Sulphide and Ammonia Gas Emanated by the Yamuna are Poisoning the Air”.

# Outlines of the Project

To study the harmful effects of a polluted Yamuna.

To prepare a questionnaire.

To survey the areas near and away from the Yamuna belt .

To collect data

To prepare graphs.

To do statistical analysis.

Conclusion



# The harmful effects of a polluted Yamuna

We came to know that the people residing near the Yamuna belt may have the following diseases caused by a polluted Yamuna.

- Asthma
- Burns & Blisters
- Bronchitis
- Headache
- Dizziness
- Vomiting & Coughing
- Stiffness
- Difficulty in breathing

# Harmful effects of H<sub>2</sub>S

Eye irritation, sore throat and cough, nausea, shortness of breath, and fluid in the lungs.

Low-level exposure may result in fatigue, loss of appetite, headaches, irritability, poor memory and dizziness.

# Harmful effects of NH<sub>3</sub>

People repeatedly exposed to ammonia may develop a tolerance (or acclimatization) for the irritating effects.

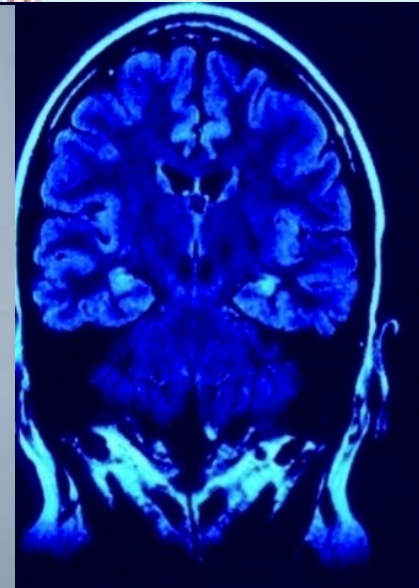
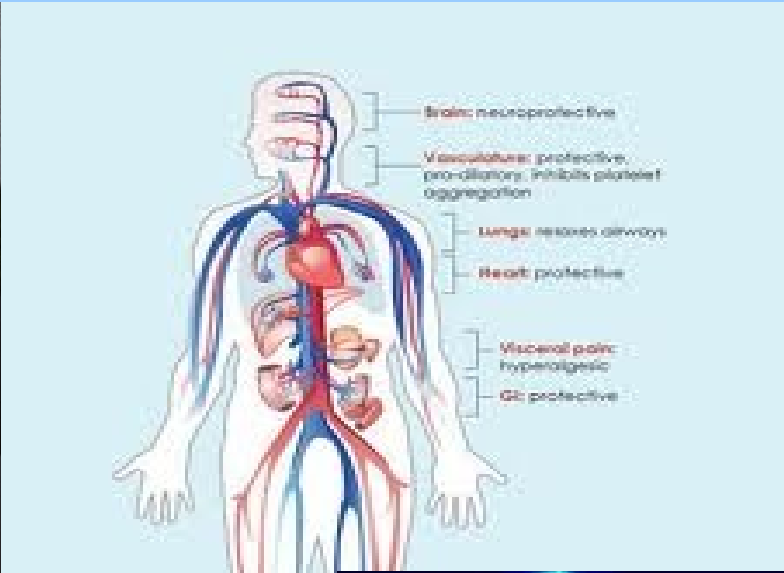
Inhalation

Skin sensitization

Respiratory sensitization

Can cause frostbite and corrosive injury to the eyes.

# Harmful effects of poisonous gases



# QUESTIONNAIRE FOR :

- v Common People
- v Doctors

# Questionnaire for the common People

NAME : \_\_\_\_\_  
GENDER : (F/M)  
AGE : \_\_\_\_\_  
RESIDENTIAL ADDRESS : \_\_\_\_\_  
PHONE NO. : \_\_\_\_\_

Are you affected by any disease? : (yes/ no)

Disease :

1-Asthama

2-Bronchitis

3-Dizziness

4-Vomiting

5-Coughing

6-Stiffness

7-Difficulty in breathing

8-Burns & Blisters

9-Headache

10-Laziness

11-Typhoid

12-Jaundice

13-Malaria

14- Any other : \_ \_ \_ \_ \_

No. of members in the family : \_\_\_\_\_

Do you work or live near the Yamuna ?

DO you use a water purifier at home ?

Is the water supplied to your home safe for drinking ?

Is your sewage system legal ?

Do you throw your non-biodegradable waste ( poly bags, plastic waste etc.) into drains ?

Do you feel that the Yamuna has become poisonous for us ?

How many times do you visit a doctor in a month ?

Do you feel any difficulty like laziness, breathing problems, headache while crossing the Yamuna?

Do you want a clean Yamuna?

Your suggestions/comments for cleaning the Yamuna.

Signature :

Date :

**CLEAN YAMUNA TO GET CLEAN DELHI**

# Questionnaire for Doctors

NAME OF HOSPITAL & CLINIC : \_\_\_\_\_  
 LOCATION : \_\_\_\_\_  
 NAME OF DOCTOR : \_\_\_\_\_  
 RESIDENTIAL ADDRESS : \_\_\_\_\_  
 TELEPHONE NO. : \_\_\_\_\_  
 MOBILE NO. : \_\_\_\_\_  
 GENDER : \_\_\_\_\_  
 No. of patients visit in a day : \_\_\_\_\_

| Disease                 | Child | Women | Men | Old |
|-------------------------|-------|-------|-----|-----|
| Asthama                 |       |       |     |     |
| Bronchitis              |       |       |     |     |
| Dizziness               |       |       |     |     |
| Vomiting                |       |       |     |     |
| Coughing                |       |       |     |     |
| Stiffness               |       |       |     |     |
| Difficulty in breathing |       |       |     |     |
| Burns & Blisters        |       |       |     |     |
| Headache                |       |       |     |     |



Did your patients work near the Yamuna belt?

-- \_\_\_\_\_

Did your patients reside near the Yamuna belt?

\_\_\_\_\_

Did they usually pass through the Yamuna belt?

\_\_\_\_\_

Your suggestions/comments for cleaning the Yamuna.

\_\_\_\_\_

**CLEAN YAMUNA TO GET CLEAN DELHI**

# Areas Surveyed

**Near the Yamuna belt      Away from the Ymuna belt**

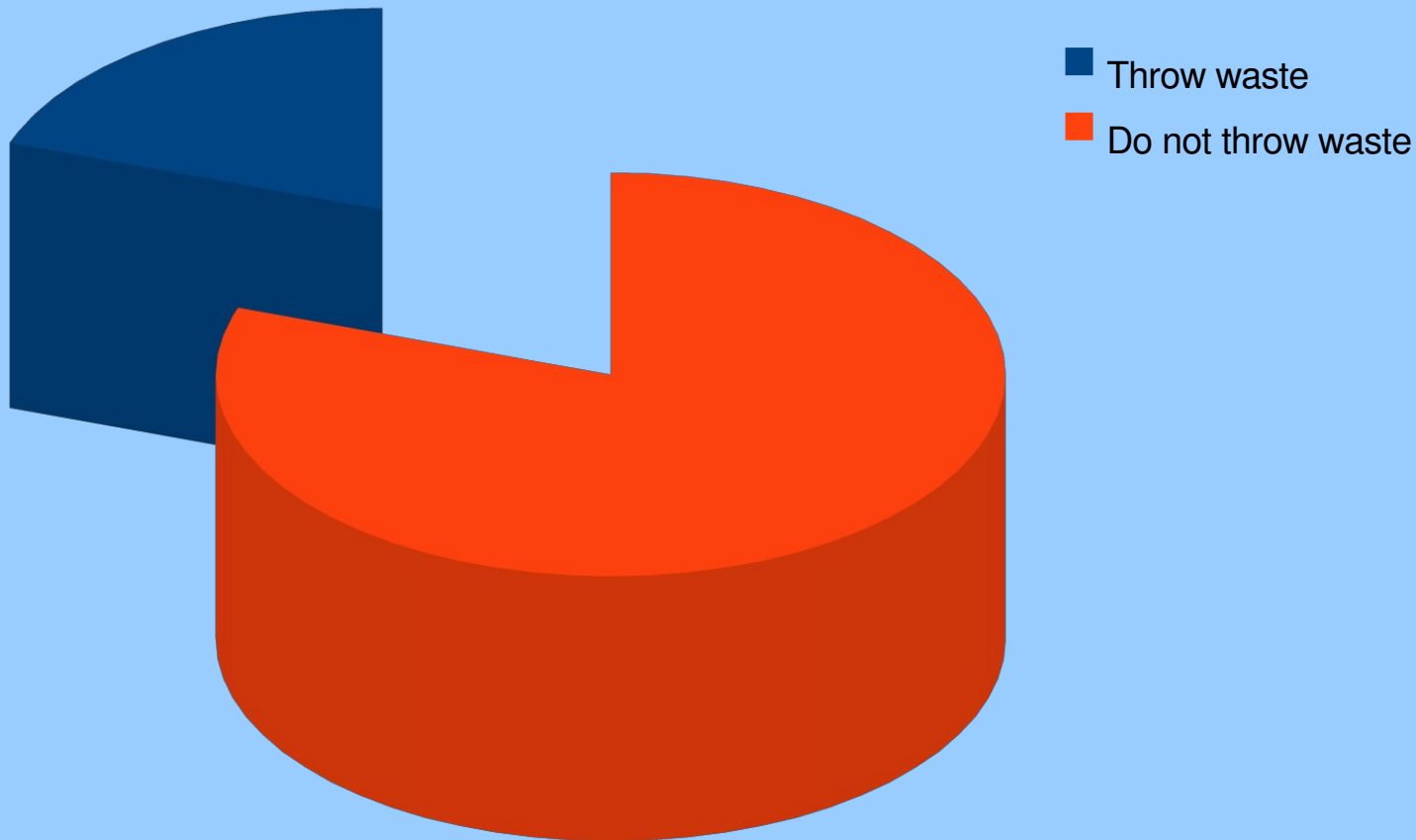
- Ø Okhla Gaon
- Ø Jamia Nagar
- Ø New Friends Colony
- Ø Kalindi Colony
- Ø Nizamuddin
- Ø Laxmi Nagar
- Ø Gandhi Nagar
- Ø Krishna Nagar
- Ø Wazirabad
- Ø Yamuna Vihar
- Ø Govindpuri
- Ø Lajpat Nagar
- Ø Nehru Place

**People who accept that  
they throw their waste in  
drains.**

People who throw their waste in drains-53

People who do not throw their waste in drains-  
217

# People who accept that they throw their waste in drains.

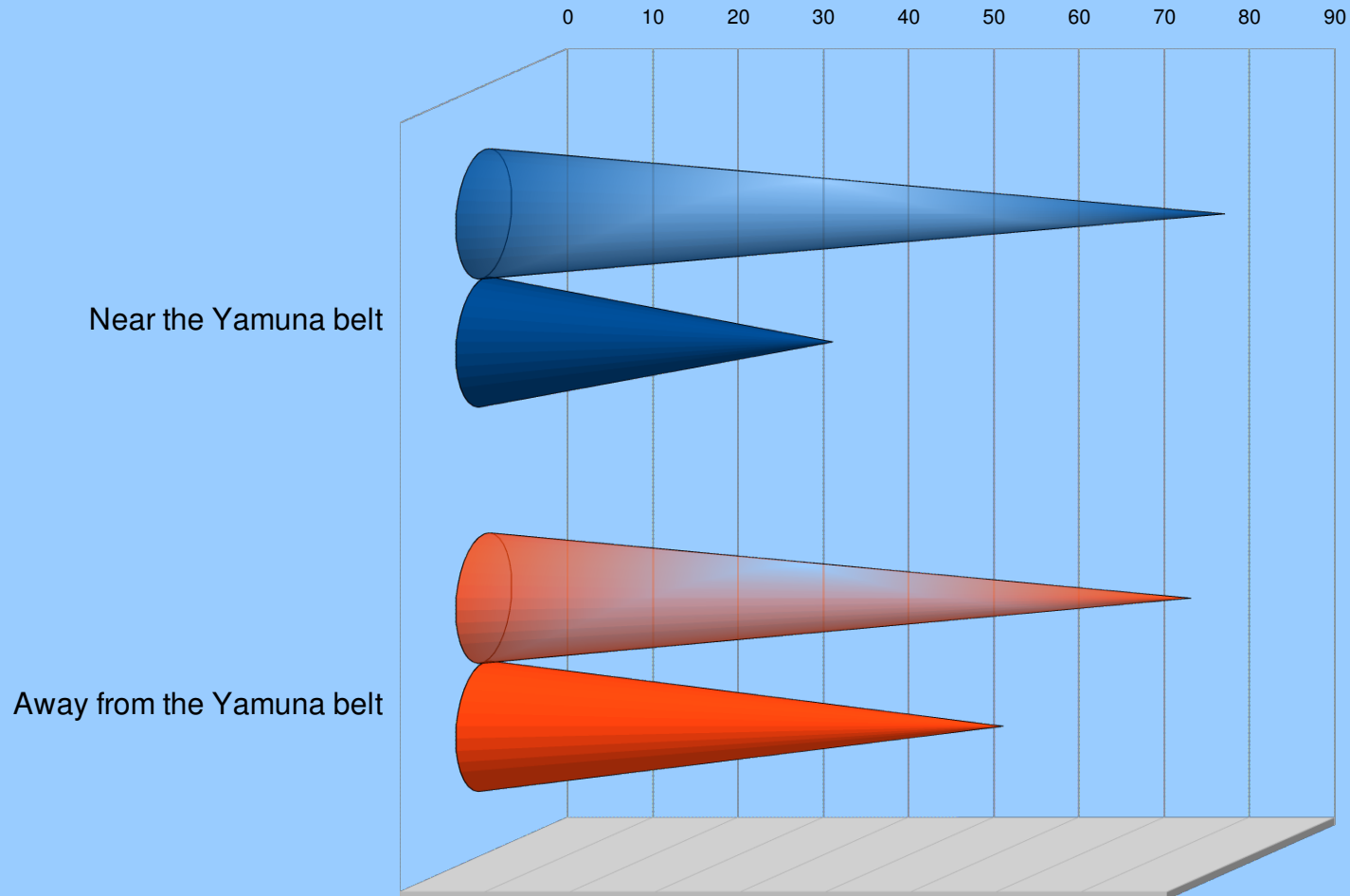


# Data During Survey

|                           | Affected By Diseases | Not Affected BY Diseases |
|---------------------------|----------------------|--------------------------|
| Near the Yamuna Belt      | 87                   | 41                       |
| Away from the Yamuna Belt | 83                   | 61                       |

# Effects on health

## Disease



We divide the whole data into two categories.

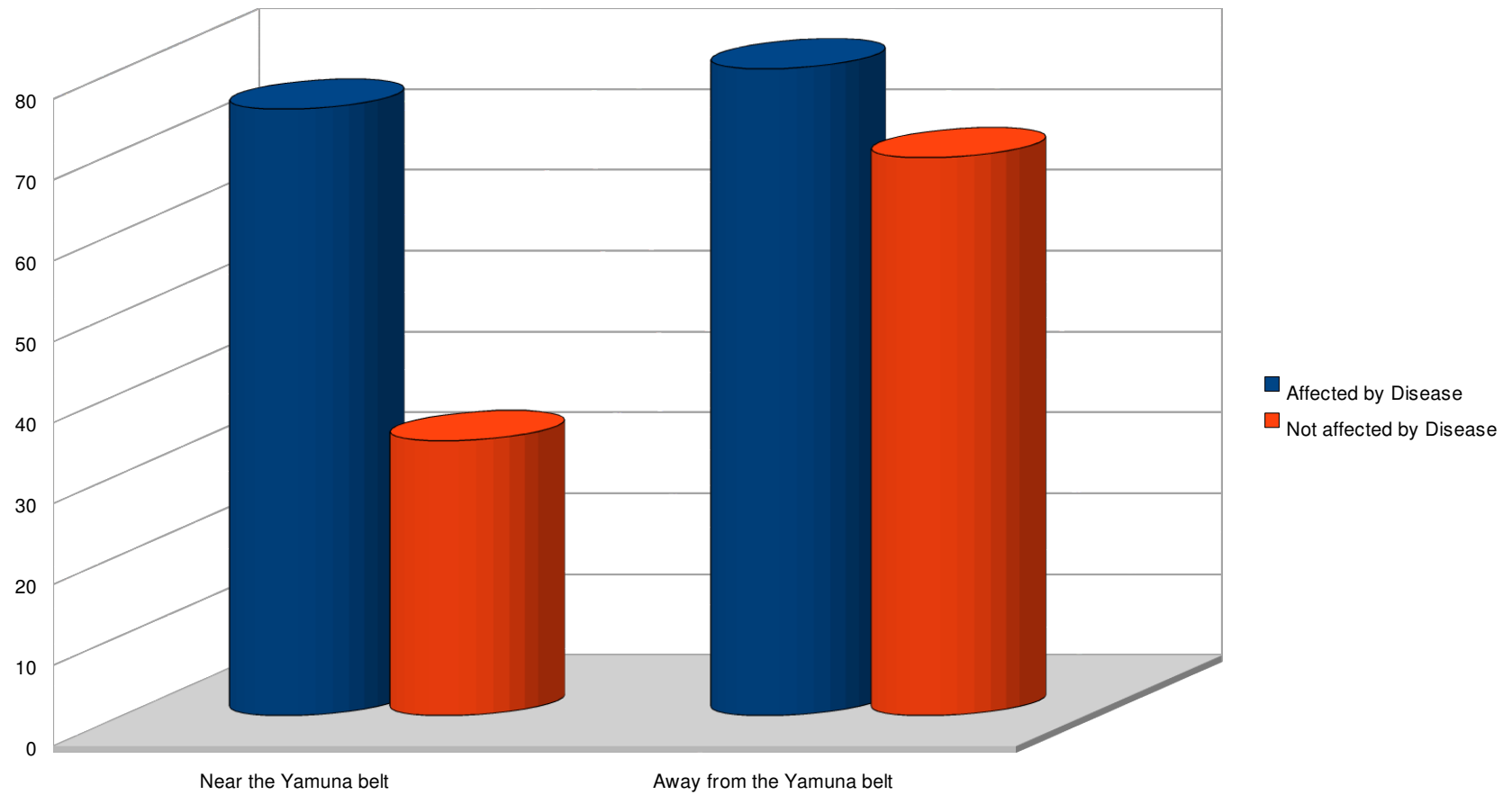
Category1-People below 50 years.

Category 2-People above 50 years

Category1

|                           | Affected by Diseases | Not Affected by Diseases |
|---------------------------|----------------------|--------------------------|
| Near the Yamuna Belt      | 75                   | 34                       |
| Away from the Yamuna Belt | 80                   | 69                       |

# Category 1

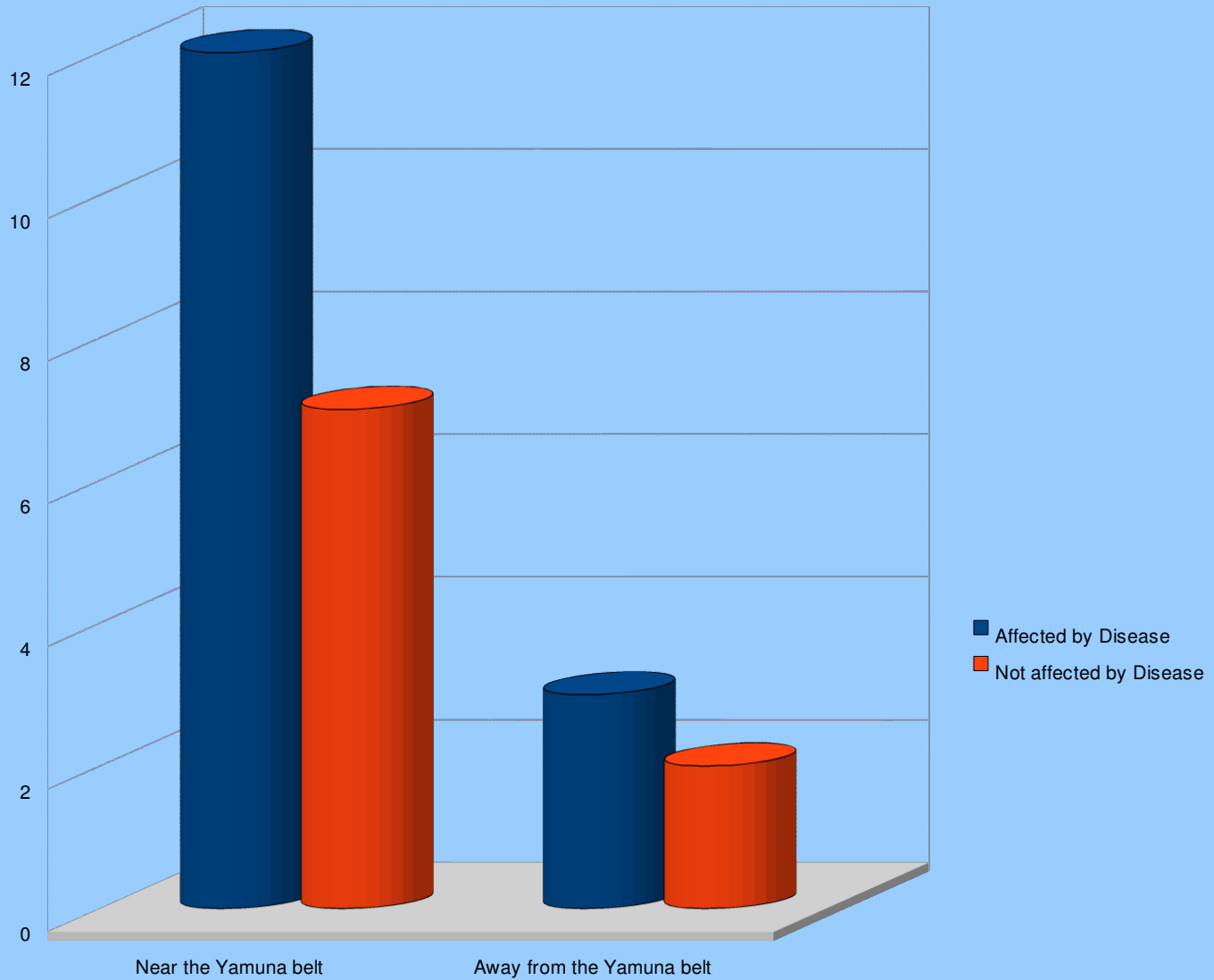




# Category 2

|                           | Affected by Disease | Not Affected by Disease |
|---------------------------|---------------------|-------------------------|
| Near the Yamuna belt      | 12                  | 07                      |
| Away from the Yamuna belt | 03                  | 02                      |

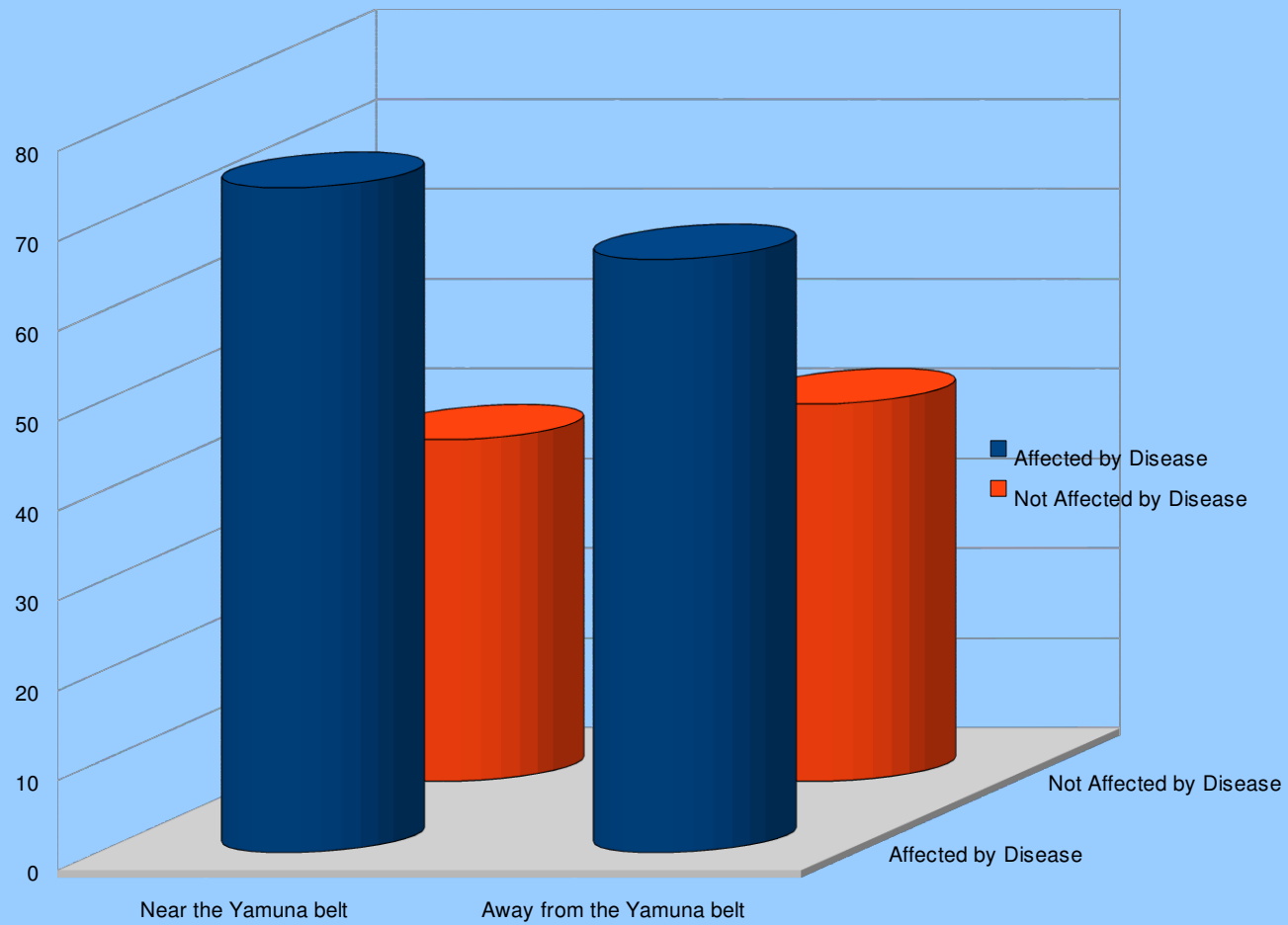
# Category 2



## Men

|                           | Affected by Disease | Not Affected by Disease |
|---------------------------|---------------------|-------------------------|
| Near the Yamuna belt      | 74                  | 38                      |
| Away from the Yamuna belt | 66                  | 42                      |

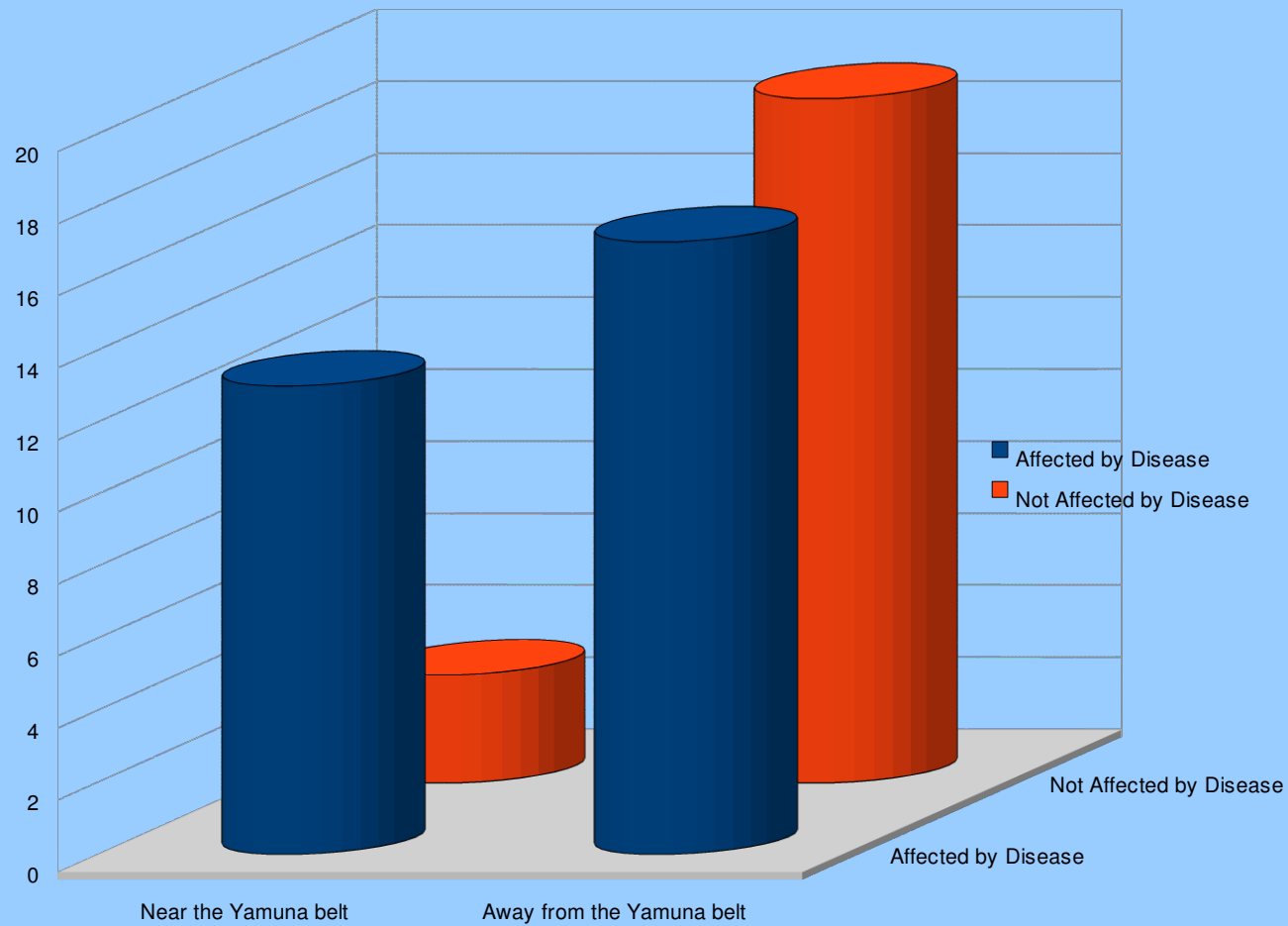
# Men



## Women

|                           | Affected by Disease | Not Affected by Disease |
|---------------------------|---------------------|-------------------------|
| Near the Yamuna belt      | 13                  | 03                      |
| Away from the Yamuna belt | 17                  | 19                      |

# Women



# Statistical Analysis

We analyzed the data statistically by using Chi-square test. For that we calculated the expected frequency.

Expected frequency =

$(\text{Row Total} \times \text{Column Total}) / \text{Total}$

Let  $e$  be the expected frequency and  $o$  be the observed frequency.

Our first query- Are the people residing near the Yamuna affected by its pollution?

We got the following data -

|                           | Affected by Disease<br>0 (e) | Not Affected by Disease<br>0 (e) |
|---------------------------|------------------------------|----------------------------------|
| Near the Yamuna belt      | 87(80)                       | 41(48)                           |
| Away from the Yamuna belt | 83(90)                       | 61(54)                           |



Thus  $\chi^2 = 3.085$  and  $\chi^2 (\text{Critical}) = 5.024$

$$\chi^2 < \chi^2(\text{Critical})$$

So we conclude that the people residing near the Yamuna belt are not affected by the polluted Yamuna.

## Our second query -Are men affected by the polluted Yamuna ?

### Men

|                           | Observed frequency<br>(expected frequency)<br>of affected people |         | Observed frequency<br>(expected frequency)<br>of not affected people |          |
|---------------------------|--|---------|--|----------|
| Near the Yamuna Belt      | 74   | (71.27) | 38   | (40.72)  |
| Away from the Yamuna Belt | 66   | (68.72) | 42   | ( 39.27) |

Thus  $\chi^2 = 0.5834$  and  $\chi^2 (\text{Critical}) = 5.024$   
 $\chi^2 < \chi^2 (\text{Critical})$

So we conclude that the men residing near the Yamuna belt are not affected by the polluted Yamuna.

# Our third query – Are women affected by the polluted Yamuna ?

## Women

|                              | Observed frequency<br>(expected frequency)<br>of affected people | Observed frequency<br>(expected frequency)<br>of not affected<br>people |
|------------------------------|--|---|
| Near the Yamuna Belt         | 13 (9.23)  | 03 ( 6.76 )   |
| Away from the<br>Yamuna Belt | 17 ( 20.76)  | 19 (5.23)   |

Thus  $\chi^2 = 5.2453$  and  $\chi^2(\text{Critical}) = 5.024$

$\chi^2 > \chi^2(\text{Critical})$

So we conclude that women are affected by the polluted Yamuna.

# Our fourth query – Is category 1 affected by the polluted Yamuna ?

## Category 1

|                  | Observed frequency<br>(expected frequency)<br>of affected people |         | Observed frequency<br>(expected frequency)<br>of not affected<br>people |          |
|------------------|--|---------|---|----------|
| Near Yamuna Belt | 75   | (65.48) | 34  | (43.51 ) |
| Away Yamuna Belt | 80   | (89.51) | 69  | (59.48)  |

Thus  $\chi^2 = 5.9966$  and  $\chi^2(\text{Critical}) = 5.024$

$\chi^2 > \chi^2(\text{Critical})$

So we conclude that Category 1 is affected by the polluted Yamuna.

# Our fifth query – Is category 2 affected by the polluted Yamuna ?

## Category 2

|                           | Observed frequency<br>(expected frequency)<br>of affected people |         | Observed frequency<br>(expected frequency) of<br>not affected people |          |
|---------------------------|--|---------|--|----------|
| Near the Yamuna Belt      | 12   | (11.87) | 7  | (7.12)   |
| Away from the Yamuna Belt | 3  | (3.12)  | 2  | ( 1.87 ) |



## Category2

Thus  $\chi^2 = 0.017$  and  $\chi^2(\text{Critical}) = 5.024$   
 $\chi^2 < \chi^2(\text{Critical})$   
So we conclude that Category 2 is  
not affected by the polluted Yamuna.

# OUR EXPERIENCE

We got support from most of the people of Delhi. We made them aware of the pollution in the Yamuna and its effect on human beings.

We also visited hospitals like AIIMS, Safderjung, Fortis, Bansal Hospital, Mahindra Hospital but the doctors and nurses refuse to fill the questionnaire. They argued with us and did not cooperate with us.

We completed our survey almost in twenty days. Though the scorching heat made us tired, it was a great learning experience.

# Steps taken by the common people and the government

Use of water purifier in homes.

People cover their faces while crossing the Yamuna in order to avoid the foul smell.

The Supreme Court has been monitoring the cleaning of the Yamuna

Yamuna Action Plan (YAP)

# Suggestions given during the survey by the common people

- People should try to clean the Yamuna.
- The government should take steps to clean the Yamuna.
- Don't allow animals in it.
- Stop dumping toxic or non biodegradable waste into it.
- Strictly ban polybags.
- Puja material, garbage should not be thrown into it.

# **Suggestions given during the survey by the common people**

- Do not release sewage and drain water into it.
- The Yamuna is the only source of fresh water in Delhi, and many lives are dependent on it so we have to save it.
- Current laws should be implemented properly.
- Pollution in the name of religion must be stopped.
- Use filtration before releasing drain water and sewage into the Yamuna.
- Social awareness and proper cleaning.

# **Suggestions given during the survey by the common people**

- Sewage treatment plants should be set up near the Yamuna.
- Drains should be covered everywhere so that no one can throw waste in them.
- Industries near the Yamuna should be shifted to other place.
- The boundaries of the Yamuna should be covered by net so that no one can throw waste into it.

# **Suggestions given during the survey by the common people**

- Every person should individually try to keep his resources neat and clean.
- The higher authorities should concentrate on the task of cleaning the Yamuna.
- The citizens of Delhi should follow the concerned policies implemented by the government.
- Ensure all time presence of security men around the Yamuna so as to stop people from throwing garbage into it.

# Conclusions

- The people living near the Yamuna belt have more breathing and foul smell problems.
- Females are affected by the polluted Yamuna .
- People below 50 yrs are affected by the polluted Yamuna .



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Thank You